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DEVELOPMENT OF FACTOR-REFERENCED SUBSCALES FOR THE VOCATIONAL I--ETC(U)
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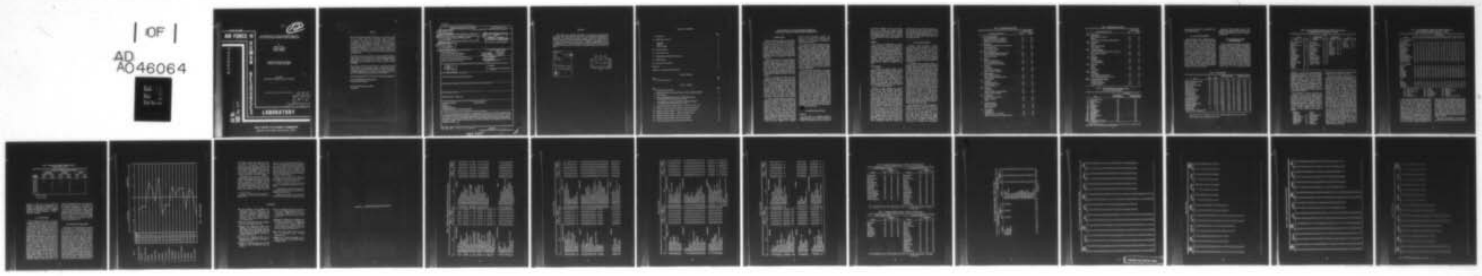

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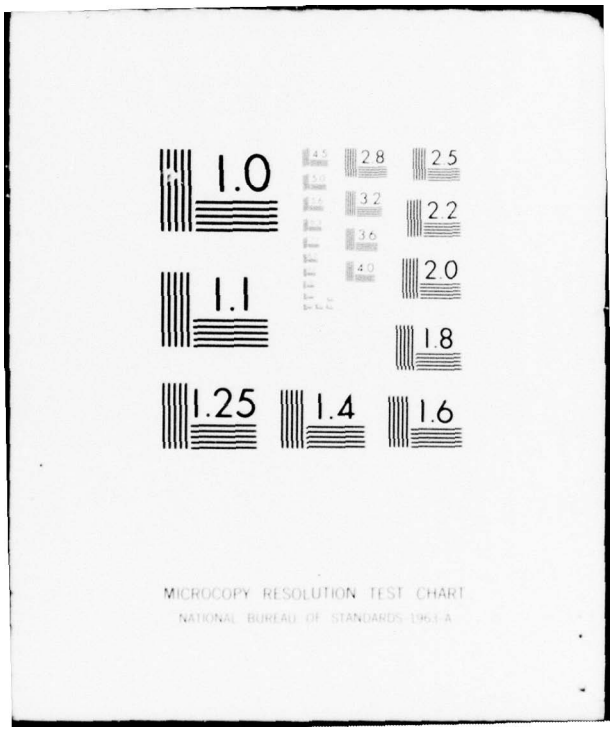
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DEVELOPMENT OF FACTOR-REFERENCED SUBSCALES FOR THE VOCATIONAL INTEREST-CAREER EXAMINATION

By

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June 1977
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AIR FORCE SYSTEMS COMMAND
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This interim report was submitted by Personnel Research Division, under project 7719, with HQ Air Force Human Resources Laboratory (AFSC), Brooks Air Force Base, Texas 78235. Mr. William E. Alley, Demographic and Attitudinal Research Branch, was the principal investigator.

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This report describes the development of factor-referenced subscales for the Vocational Interest-Career Examination (VOICE). The 400-item inventory was administered to random samples of Air Force male (N = 10,035) and female (N = 12,710) recruits. Eighteen integer-weighted subscales were constructed based on a factor analysis of item responses. Psychometric and normative data on the scales are presented for both male and female subgroups. Concurrent validation studies were performed with the Navy Vocational Interest Inventory and the Army Classification Inventory.

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PREFACE

This research was conducted under Project 7719, Selection and Classification Technology, task 771909, Specialized Procedures to Improve Personnel Classification and Assignment. The investigation was made in response to RPR 74-24, Development of Improved Techniques for Estimating Person-Job Compatability. The authors would like to express their appreciation to Major Wayne S. Sellman (AFMPC/DPMYR) for his continuing support as requirements manager for the project and to Mr. Charles Greenway (AFHRL/SM) and his staff for the excellent computational support they provided to the effort.

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DEVELOPMENT OF FACTOR-REFERENCED SUBSCALES FOR THE VOCATIONAL INTEREST-CAREER EXAMINATION

I. INTRODUCTION

Without considerable experience in the civilian labor market, it is often difficult for prospective Air Force enlistees to select the most appropriate vocational or technical career. The process of matching the right person with the right job requires careful consideration of the recruit's interests and abilities in relation to the wide range of jobs typically available at the entry level. This is particularly true in view of the fact that initial assignment contracts are binding for a minimum of 4 to 6 years.

Some of the uncertainty in these decisions is reduced through the use of systematic aptitude assessment which delimits those jobs for which the recruit is mentally qualified. Moreover, the needs of the service may further restrict job availability. Once these constraints are met, however, the recruit may still have considerable latitude to choose among several competing occupations without first-hand knowledge of the jobs or the duties involved.

Given the informality with which vocational preferences are considered in the current job-placement system, it is understandable that each year a large number of recruits enter career fields that are inconsistent with their personal interests. The resulting dissatisfaction leads a certain proportion of these people to retrain into other specialties while those obligated to remain in dissatisfying careers are more likely to separate from service prematurely. In either case, additional personnel costs associated with recruiting, processing, and training replacements are incurred.

In 1973, a research program was initiated to improve the quality of vocational guidance and job placement procedures in the Air Force. The specific objectives were to develop a standardized assessment system for measuring vocational interests at point of entry and to evaluate the utility of this information in the selection of an appropriate vocational or technical career field. Initial efforts to construct a suitable instrument for the project were performed under contract with the Educational Testing Service (Echternacht, Reilly, & McCaffrey, 1973). This work led to the development of a general purpose vocational interest inventory designated the Vocational Interest Career Examination (VOICE). The purpose of this report is to document the construction of factor-referenced homogeneous subscales for the inventory.

The utility of homogeneous scaling has been well documented in past research (Campbell, Borgen, Eastes, Johansson, & Peterson, 1967; Clark, 1961; Kuder, 1942). Given a large number of individual item responses that may be difficult or cumbersome to interpret, it is often desirable to seek some means for summarizing the information using a relatively few descriptive indices. The number and nature of these indices are determined by examining relationships between items, clustering those which seem to measure the same underlying dimension. This approach is analogous to factor-analytic methods which seek to identify common underlying factors among a number of different measurements.

The present study was designed to circumvent several potential problem areas typically encountered in this type of research (see Buros, 1975, for a review of this literature). The initial item pool was sufficiently broad to cover a wide array of vocational and technical interests. Item responses were obtained in the free-, rather than forced-choice format to preclude difficulties with ipsative scoring. Sample sizes were large and differentiated on the basis of sex to permit stable generalizations for both male and female respondents. And finally, rigorous factor-analytic methods were used to provide a sound and replicable basis for the analysis. Specific attention was directed to the following issues: (a) identification of the basic interest dimensions underlying individual item responses to the VOICE, (b) construction of integer weighted subscales to replicate the dimensions, (c) evaluation of the subscales for suitable psychometric properties, and (d) concurrent validation of the scales with other Department of Defense interest inventories.

II. VOICE FACTOR STRUCTURE

Item Pool

The basic data for the analysis consisted of individual responses to the VOICE. The inventory contains 400 multiple-choice items divided into

four general categories: job titles, work tasks, spare time activities, and desired learning experiences. The respondent is asked to indicate relative preferences for each item in a standard like-indifferent-dislike format. Total testing time for completing the inventory is approximately 35 minutes.

Subjects

The inventory was administered to random samples of male (N = 10,035) and female (N = 12,710) recruits during 1973–74 at Lackland Air Force Base, Texas. Subjects ranged in age from 17 to 26 years; most had completed high school or some college. In general, they were representative of all-volunteer recruits entering the Air Force during that time period. Female recruits, which currently represent approximately 13% of accessions, were deliberately over-sampled to obtain sufficient numbers of responses from this group.

Factor Analyses

To establish the factor structure of the inventory, item intercorrelation matrices (400 x 400) were generated separately for the male and female samples. Item responses were coded 3 = like, 2 = indifferent, and 1 = dislike. Each of the matrices was subjected to a principal axis factor analysis with varimax rotation (Veldman, 1967). Various extraction limits were examined to determine the appropriate number and character of the resulting factors. Limits were set to provide 16, 21, 26, and 35 varimax factors.

Results of these analyses were virtually identical for the male and female subgroups at each extraction level. Moreover, the factors extracted at lower limits within each sample appeared to be invariant as more and more factors were extracted and rotated. In the process, 18 orthogonal factors were identified and labeled as shown in Table 1. These factors represented 48% of the original variance in the male sample and 46% in the female sample. The most consistent factors, labeled I through XII in the table, could be seen in the 16-, 21-, 26-, and 35-factor solutions. The remaining factors were most evident in the 26-factor solution as factors XIII through XVIII and XXVI. Representative items for each of the 18 factors are shown in the table together with factor loadings obtained in the male and female subsamples. The order in which the factors are shown corresponds to the degree to which each factor encompassed smaller and smaller item clusters. The first factor (Office Administration), for example, had more than 60 items in the inventory with associated loadings above .30. The last factor (Automated Data Processing), on the other hand, had approximately seven items above this minimum cutoff.

III. SCALE DEVELOPMENT

Although it would be possible to compute factor scores for each respondent as a means for describing his interests, to do so would not be convenient from an operational point of view. Each score would represent the weighted composite of 400 item responses, each contributing uniquely to the system. The processing of these scores would require access to computing machinery which might not be readily available to the general user.

To simplify scoring individual profiles, an attempt was made to construct integer-weighted subscales which could serve in lieu of the more complex scoring system. These scales would represent the summation of a relatively few items per scale and could be obtained by hand if necessary. Following more or less traditional guidelines, the factor loadings for items within each dimension were rank ordered from highest to lowest. Items were selected to represent a given dimension beginning with those with the highest loadings and continuing until one of two criteria were met: (a) A maximum of 20 items was selected or (b) Item loadings fell below an arbitrary minimum cutoff of .30. As a check on the procedure, supplementary analyses were performed to examine the correspondence between the integer-weighted subscales and their factor score equivalents. Correlations shown in the first column of Table 2 represent the simple bivariate relationships between factors and corresponding scales. The second column reflects the multiple R obtained using all unit-weighted subscales in combination to estimate each of the factor scores.

Scores obtained on the *Office Administration* subscale, for example, correlated .94 with the corresponding factor score. The use of additional subscales increased the correlation to .97 accounting for approximately 94% of the factor-score variance. The bivariate R's ranged from a high of .94 to a low of .49. The multiple R's were all above .90 with the exception of three factors. Across all factors, the amount of information loss resulting from unit-weighted

Table 1. **Orthogonal Interest Factors**

	Factor/Representative Items	Factor Loading	
		Male	Female
I	**Office Administration**		
	Keep personnel records on employees	.74	.70
	Organize a file system for an office	.72	.73
	Take inventory for a department store	.70	.66
II	**Electronics**		
	Find a problem in an electric circuit and fix it	.79	.80
	Test television tubes	.72	.73
	Technician (electronics)	.72	.69
III	**Heavy Construction**		
	Pour concrete for highway construction	.69	.61
	Operate a bulldozer or power shovel	.64	.58
	Construction worker	.62	.55
IV	**Science**		
	Write a scientific report	.65	.68
	Work in a scientific laboratory	.79	.82
	Use chemical laboratory apparatus	.75	.77
V	**Outdoors**		
	Go canoeing	.60	.58
	Learn survival techniques	.61	.48
	Spend a week at the seashore	.67	.61
VI	**Medical Service**		
	Perform physical therapy	.59	.62
	Assist a surgeon during an operation	.60	.73
	Dental hygienist	.55	.57
VII	**Aesthetics**		
	See a Broadway play	.48	.50
	Read Shakespeare's plays	.59	.57
	Listen to an opera	.61	.66
VIII	**Mechanics**		
	Tune-up a car	.66	.51
	Adjust the brakes on an automobile	.61	.46
	Supervise work in a garage	.44	.29
IX	**Food Service**		
	Work as a short-order cook	.62	.62
	Manage a cafeteria	.45	.54
	Chef	.65	.70
X	**Law Enforcement**		
	Highway patrolman	.71	.68
	Private investigator	.56	.52
	Prison guard	.56	.52
XI	**Audiographics**		
	Photographer	.65	.69
	Operate a 16mm movie camera	.62	.67
	Record the sound track for a motion picture	.48	.55

Table 1. Orthogonal Interest Factors

	Factor/Representative Items	Factor Loading Male	Factor Loading Female
XII	**Mathematics**		
	Solve arithmetic problems	.67	.75
	Algebra	.61	.67
	Devise short-cut methods for adding numbers	.48	.52
XIII	**Agriculture**		
	Farmer	.54	.57
	Work as a game warden	.47	.55
	Train animals	.41	.54
XIV	**Teacher/Counseling**		
	Listen to people's problems and try to help them	.40	.53
	Give on-the-job training	.35	.48
	Teacher	.36	.49
XV	**Marksman**		
	Gunsmith	.55	.55
	Go deer hunting	.48	.53
	Teach marksmanship	.48	.46
XVI	**Craftsman**		
	Tailor	.35	.56
	Jeweler	.30	.30
	Watchmaker	.34	.24
XVII	**Drafting**		
	Draw graphs	.52	.50
	Draw maps from photographs	.48	.49
	Draw a topographical map of the US	.46	.46
XVIII	**Automated Data Processing**		
	Computer operator	.70	.77
	Computer programmer	.70	.77
	Keypunch operator	.45	.53

Table 2. **Relationships Between Orthogonal Interest Factors and VOICE Subscales[a]**

	Factor	Correlations[b] Corresponding VOICE Subscale (R)	Correlations[b] All VOICE Subscales Combined (Mult R)
I	Office Administration	.94	.97
II	Electronics	.94	.98
III	Heavy Construction	.88	.96
IV	Science	.87	.98
V	Outdoors	.83	.93
VI	Medical Service	.79	.97
VII	Aesthetics	.73	.93
VIII	Mechanics	.73	.95
IX	Food Service	.79	.96
X	Law Enforcement	.84	.95
XI	Audiographics	.72	.93
XII	Mathematics	.71	.94
XIII	Agriculture	.69	.92
XIV	Teacher/Counseling	.52	.80
XV	Marksman	.69	.86
XVI	Craftsman	.49	.71
XVII	Drafting	.69	.90
XVIII	Automated Data Processing	.65	.90

[a]Unit-Weighted.

[b]Corelations indicate the extent of relationship between interest factors, corresponding VOICE subscales (Col 1), and all VOICE subscales combined (Col 2).

scoring (approximately 15%) was considered to be within acceptable limits.

IV. SCALE CHARACTERISTICS

Summary statistics for the VOICE subscales are presented in Table 3. For each scale, the table catalogs the number of items, score range, raw score means and standard deviations by sex group, and internal item consistencies (Cronbach, 1951). As can be noted in the table, the scales range in length from 7 to 20 items. With few exceptions, the internal consistencies (for both the male and female subgroups) range from the high 80's to mid 90's. A comparison of male and female average raw score values indicates that males typically scored higher on Electronics, Heavy Construction, Mechanics, Law Enforcement, and Marksman subscales. Female respondents, as a group, typically scored higher on Office Administration, Medical Service, Aesthetics, Food Service, Audiographics, Agriculture and Teacher/Counseling.

Individual items contained in each scale together with associated item statistics for the male and female subgroups are shown in Appendix A (Table A1).

V. RELATIONSHIPS WITH OTHER DOD INVENTORIES

Recent emphasis on developing common testing procedures across services provided a rationale for analyzing the concurrent validity of the VOICE with respect to comparable instruments from both the Army and Navy. A reference sample consisting of 1,390 recruits (87% male; 13% female) was administered the Navy Vocational Interest Inventory (NVII), the Army Classification Inventory (ACI), and the VOICE. The NVII contains 190 forced-choice item triads that require respondents to select the most and least preferred alternatives presented with each item. As shown in Table 4, the inventory yields nine area scores of the same general type as the 18 homogeneous VOICE

Table 3. **VOICE Subscales**

Scale	No of Items	Score Range[a]	Males (N = 10,035) $\bar{X}$	Males SD	Males α[b]	Females (N = 12,710) $\bar{X}$	Females SD	Females α[b]
Office Administration (OA)	20	20–60	32.32	10.71	.95	37.85	11.46	.95
Electronics (EL)	20	20–60	40.72	12.78	.96	32.50	12.15	.96
Heavy Construction (HC)	20	20–60	34.41	9.99	.93	27.49	8.37	.93
Science (SC)	20	20–60	38.02	12.69	.96	38.21	12.81	.96
Outdoors (OD)	15	15–45	36.47	6.88	.88	36.67	5.76	.83
Medical Service (MS)	20	20–60	33.38	10.55	.94	40.81	11.47	.94
Aesthetics (AE)	15	15–45	26.10	7.74	.90	31.78	7.36	.88
Mechanics (ME)	15	15–45	31.65	8.98	.94	25.10	8.69	.94
Food Service (FS)	15	15–45	21.36	6.30	.90	26.72	7.40	.90
Law Enforcement (LE)	15	15–45	29.22	7.30	.88	26.90	6.89	.86
Audiographics (AU)	10	10–30	20.76	5.79	.90	22.26	5.45	.88
Mathematics (MA)	12	12–36	21.50	7.37	.93	22.06	7.44	.92
Agriculture (AG)	15	15–45	28.00	7.15	.88	31.04	8.00	.90
Teacher/Counseling (TC)	10	10–30	19.32	5.73	.89	22.22	5.31	.86
Marksman (MK)	7	7–21	15.38	4.28	.86	11.54	4.22	.86
Craftsman (CF)	7	7–21	9.88	2.95	.79	11.22	2.96	.72
Drafting (DF)	7	7–21	13.25	4.20	.85	13.08	4.28	.86
Automated Data Processing (DP)	7	7–21	13.76	4.49	.89	13.86	4.39	.88

[a]Items scored 3 = Like; 2 = Indifferent; and 1 = Dislike; missing or otherwise invalid responses recoded = 2.

[b]Alpha coefficient of internal consistency (uncorrected).

Table 4. **Means and Standard Deviations for the VOICE, NVII, and ACI on a Sample of Air Force Recruits (N = 1,390)**

VOICE			NVII						ACI		
			Lambda Scores			Area Scores					
Scale	$\bar{X}$	SD	Subscale	$\bar{X}$	SD	Subscale	$\bar{X}$	SD	Subscale	$\bar{X}$	SD
Office Administration	33	10	Quartermaster	.33	.16	Mechanical	47	9	Combat	18	3
Electronics	42	13	Sonar Technician	.34	.22	Health	53	9	Mechanical	12	5
Heavy Construction	36	10	Electronics Technician	.32	.23	Office	49	8	Electronics	10	5
Science	40	12	Radioman	.33	.18	Electrical	49	9	Administrative	10	3
Outdoors	38	6	Data Processing	.29	.14	Food Service	50	9			
Medical Service	35	10	Store Keeper	.17	.13	Carpentry	47	8			
Aesthetics	27	7	Commissary Man	.24	.14	Sales Office	53	7			
Mechanics	33	9	Engine Man	.30	.26	Clean Hands	50	7			
Food Service	23	6	Boiler Man	.30	.26	Outdoors	45	8			
Law Enforcement	30	7	Electrician's Mate	.32	.25						
Audiographics	22	5	Equipment Operator	.31	.24						
Mathematics	23	7	Aviation Ord Man	.33	.23						
Agriculture	30	7	Air Control man	.34	.17						
Teacher/Counseling	20	5	Aviation Electrician	.33	.24						
Marksman	16	4	Hospital Corpsman	.20	.17						
Craftsman	10	3									
Drafting	14	4									
Auto D. P.	14	4									

subscales. An alternate scoring procedure developed by Dann and Abrahams (1973) yields occupational composites in 15 Navy specialties designated "lambda" scores. The Army's Classification Inventory, as used in their operational selection and classification program, provides interest measures in four general areas: Combat, Mechanical, Electronics, and Administrative. The item format in the ACI is free-response as in the VOICE. Means and standard deviations for the Air Force recruit sample across all three inventories are also shown in Table 4.

Correspondence between inventories was evaluated in two ways. First, simple bivariate correlations between individual VOICE subscales and those of the NVII and ACI were obtained to examine one-to-one relationships among the subscales. Second, a series of multiple correlation analyses were performed to determine the extent to which all scales in a given inventory could be used to replicate individual scales found in another. Six such analyses were conducted as follows:

Predictors		Criteria
VOICE (18)	vs.	NVII-Lambda (15)
NVII-Lamdba (15)	vs.	VOICE (18)
VOICE (18)	vs.	NVII-Area (9)
NVII-Area (9)	vs.	VOICE (18)
VOICE (18)	vs.	ACI (4)
ACI (4)	vs.	VOICE (18)

Split sample cross-validations were also performed within each set as a check for over-fitting.

Results of the bivariate correlation analyses, as shown in Table 5, indicated varying degrees of correspondence between individual VOICE subscales and those obtained from other inventories. Correlates above .60 were found for the Office Administration, Electronics, Mechanics, and Mathematics subscales. The Office Administration subscale, for example, correlated .61 with the NVII Office Scale and .61 with the ACI Administrative Scale while the Electronics subscale correlated .68 with the NVII Electronics measure and .69 with the corresponding scale in the ACI. Somewhat lower, but still indicative of significant overlapping variance, were scores on the VOICE Electronics subscale and the NVII Sonar Technician, Electronics Technician, Radio Man, Boiler Man, Electrician's Mate, and Aviation Electrician. The Heavy Construction subscale correlated in the low and mid-fifties with scales on both the NVII and the ACI. The Medical Service subscale correlated .50 with the NVII Hospital Corpsman and .58 with the NVII Health scale. The VOICE Mechanics subscale correlated in the .50 to .66 range with nine of the NVII-Lambda scores, .64 with the NVII Mechanical scale, and .69 with the ACI Mechanical scale. Although other relationships were found, they were, in most cases, not large enough to verify direct one-to-one correspondence between the scales.

Table 5. **Correlations Between Scales on the VOICE, NVII and ACI Based on a Sample of Air Force Recruits (N = 1,390)**

Scale	VOICE Scales																	
	OA	EL	HC	SC	OD	MS	AE	ME	FS	LE	AU	MA	AG	TC	MK	CF	DF	DP
NVII – Lambda Scores																		
Quartermaster	−33	34	28	22	42	−12	−08	42	−21	18	13	08	23	−04	36	−08	29	00
Sonar Technician	−41	57	39	17	32	−18	−19	58	−19	13	08	02	18	−19	39	−02	19	03
Electronic Technician	−41	58	39	21	31	−17	−17	58	−18	12	09	05	19	−19	38	−01	22	05
Radio Man	−30	54	31	15	31	−22	−18	51	−24	13	09	07	12	−14	37	−05	21	10
Data Processing	−13	40	22	18	32	−18	−16	41	−24	11	06	22	08	−04	31	−09	21	16
Store Keeper	41	−21	−21	−14	03	−13	−08	−18	−16	02	−09	21	−18	16	−05	−17	−07	17
Commissary Man	−37	14	36	−12	33	−22	−29	42	03	18	−09	−17	24	−22	34	−12	−03	−24
Engine Man	−44	49	51	−02	27	−29	−32	66	−17	12	−05	−11	17	−31	42	−02	10	−09
Boiler Man	−42	51	50	−01	27	−29	−32	65	−28	12	−04	−10	16	−30	42	−02	11	−07
Electrician's Mate	−42	57	46	06	28	−25	−27	63	−18	11	01	−04	16	−26	40	−01	14	−02
Equipment Operator	−44	45	50	−03	30	−29	−31	63	−17	14	−05	−13	19	−29	42	−04	11	−12
Aviation Ordinance Man	−43	47	47	02	32	−27	−29	62	−17	15	−02	−08	19	−27	43	−04	13	−08
Air Control Man	−35	37	29	23	42	−11	−10	44	−20	20	13	07	21	−05	38	−08	27	01
Aviation Electrician	−41	57	44	11	30	−22	−24	62	−19	12	04	−02	17	−24	41	−01	17	01
Hospital Corpsman	−08	−08	−10	47	30	50	25	−11	01	23	20	17	28	30	08	−06	16	02
NVIII – Area Scores																		
Mechanical	−39	53	48	−06	14	−32	−27	64	−13	02	−05	−13	07	−34	33	04	09	−07
Health	06	−14	−18	45	08	58	27	−23	11	10	16	16	17	25	−07	04	07	07
Office	61	−32	−40	−06	−23	07	12	−45	−01	−14	−03	24	−28	23	−30	−01	−10	27
Electrical	−23	68	19	04	03	−23	−14	39	−15	−03	08	−01	−05	−22	18	04	07	17
Food Service	−11	−24	−09	−10	−04	02	01	−15	44	−01	−03	−15	09	−05	−09	−01	−13	−24
Carpentry	−10	−25	25	−31	06	−17	−14	09	07	01	−23	−21	14	−10	08	−04	−04	−32
Sales Office	17	−24	−35	26	01	27	40	−41	08	03	23	18	00	37	−21	02	14	10
Clean Hands	42	−24	−30	−04	−15	09	09	−36	−04	00	03	14	−22	20	−19	−01	−06	22
Outdoors	−31	24	40	−12	21	−19	−36	44	−16	09	−24	−12	14	−26	29	−10	−03	−18
ACI																		
Combat	−19	19	36	19	45	09	01	31	−01	39	09	01	29	04	46	00	14	−04
Mechanical	−06	57	58	17	32	01	02	69	11	24	18	07	30	01	43	21	24	09
Electronics	20	69	24	55	26	23	29	34	13	17	35	64	21	32	24	25	43	46
Administrative	61	00	−19	26	05	29	35	−17	10	03	21	43	−04	47	−09	16	18	38

OA – Office Administration
EL – Electronics
HC – Heavy Construction
SC – Science
OD – Outdoors
MS – Medical Service
AE – Aesthetics
ME – Mechanics
FS – Food Service
LE – Law Enforcement
AU – Audiographics
MA – Mathematics
AG – Agriculture
TC – Teacher/Counseling
MK – Marksman
CF – Craftsman
DF – Drafting
DP – Automated Data Processing

The results of the multiple correlation analysis, shown in Tables A2 through A4 and summarized in Table 6, indicate to what extent scores in a given instrument, when combined in composite form, can be used to replicate scales in other inventories. As can be noted in Table 6, the VOICE subscales generally replicated scores in the NVII and ACI more completely than could these inventories replicate the VOICE scales. In the VOICE versus NVII comparisons, the multiple R's obtained using the VOICE subscales to predict each NVII-Lambda scale, in turn, ranged from .70 to .87. These values are quite high, indicating, in some cases, almost complete replication of the scales. When the NVII-Lambda scales were used as predictors, only 3 of the 18 VOICE subscales could be estimated with equivalent accuracy. Similar findings were noted in the second and third sets of comparisons. Multiple correlations ranged from .60 to .84 when the VOICE was used to predict the NVII-Area scores and from .62 to .83 when the VOICE was used to predict the four ACI scales. Neither the NVII nor the ACI were able to estimate individual VOICE subscales with the same degree of accuracy.

Split-sample cross-validation of these results, also shown in Tables A2 through A4, indicated the

Table 6. Summary 6f Multiple Correlation Analyses – VOICE vs. NVII vs. ACI

	Frequency Distribution of Multiple Correlations					
	VOICE vs. NVII—Lambda		VOICE vs. NVII—Area		VOICE vs. ACI	
Multiple Correlation Range	VOICE[a] vs. NVII-L[b]	NVII-L[a] vs. VOICE[b]	VOICE[a] vs. NVII-A[b]	NVII-A[a] vs. VOICE[b]	VOICE[a] vs. ACI[b]	ACI[a] vs. VOICE[b]
80–89	8		3		2	
70–79	7	3	1	1		3
60–69		4	5	2	2	2
50–59		4		3		5
40–49		6		4		3
30–39				6		3
20–29		1		1		1
10–19				1		1

[a]Predictor variables.

[b]Criterion Variables.

sample of 1,390 cases was quite stable for purposes of making these generalizations. The amount of shrinkage associated with each multiple correlation was generally found to be negligible, using only a random half-sample on which to construct a composite.

VI. VOICE PROFILES

When vocational interest data are used for comparative purposes, it is often more meaningful to convert raw scores obtained on the subscales to a standardized metric system. Interpretation of interest profiles for an individual or group can be enhanced if the mean and standard deviation of scores obtained on each subscale are fixed at some constant value. Tables A5 and A6 show one such transformation in the form of T-scores where the average value of each subscale for a given reference group is set at 50 and the standard deviation of scores around that average is set at a value of 10. These conversions are based on the normative data for male and female Air Force recruits shown previously in Table 3. A profile of the transformed scores for a randomly selected male recruit is shown in Figure 1. The subscales are listed in the left margin. Across the top of this illustration, the T-score values ranged from 20 to 80 with the larger number indicating a higher affinity for the keyed activities. Both raw scores and T-score equivalents are shown for each subscale. This respondent displays marked preferences for the Science and Aesthetics subscales. Somewhat lower, but still above average, were scores obtained on the Outdoors, Audiographics, Agriculture, and Teacher/Counseling subscales. Below average scores were noted on Mechanics, Automated Data Processing, Office Administration, and Marksman. Based on the profile, this recruit would probably be more satisfied in an occupation involving natural or social science work than he would be for other occupational choices.

VII. SUMMARY AND CONCLUSIONS

The domain of vocational interests as measured by the VOICE can be characterized by a limited set of dimensions that, in form and substance, are virtually identical for male and female respondents. In the present study, 18 common interest dimensions were identified using factor analytic techniques. The amount of original item variance accounted for by the factors ranged from 48% in the male sample to 46% in the female sample. A simple unit-weighted scoring technique for these dimensions replicated the original factor space almost entirely. Internal consistency value of items within the homogeneous subscales ranged from .79 to .96 for male respondents and from .72 to .96 for female respondents. Normative data based on 10,035 males and 12,710 females indicated that while the subscales may have identical meaning for both sexes, the degree of preference associated with each subscale was not always similar for both

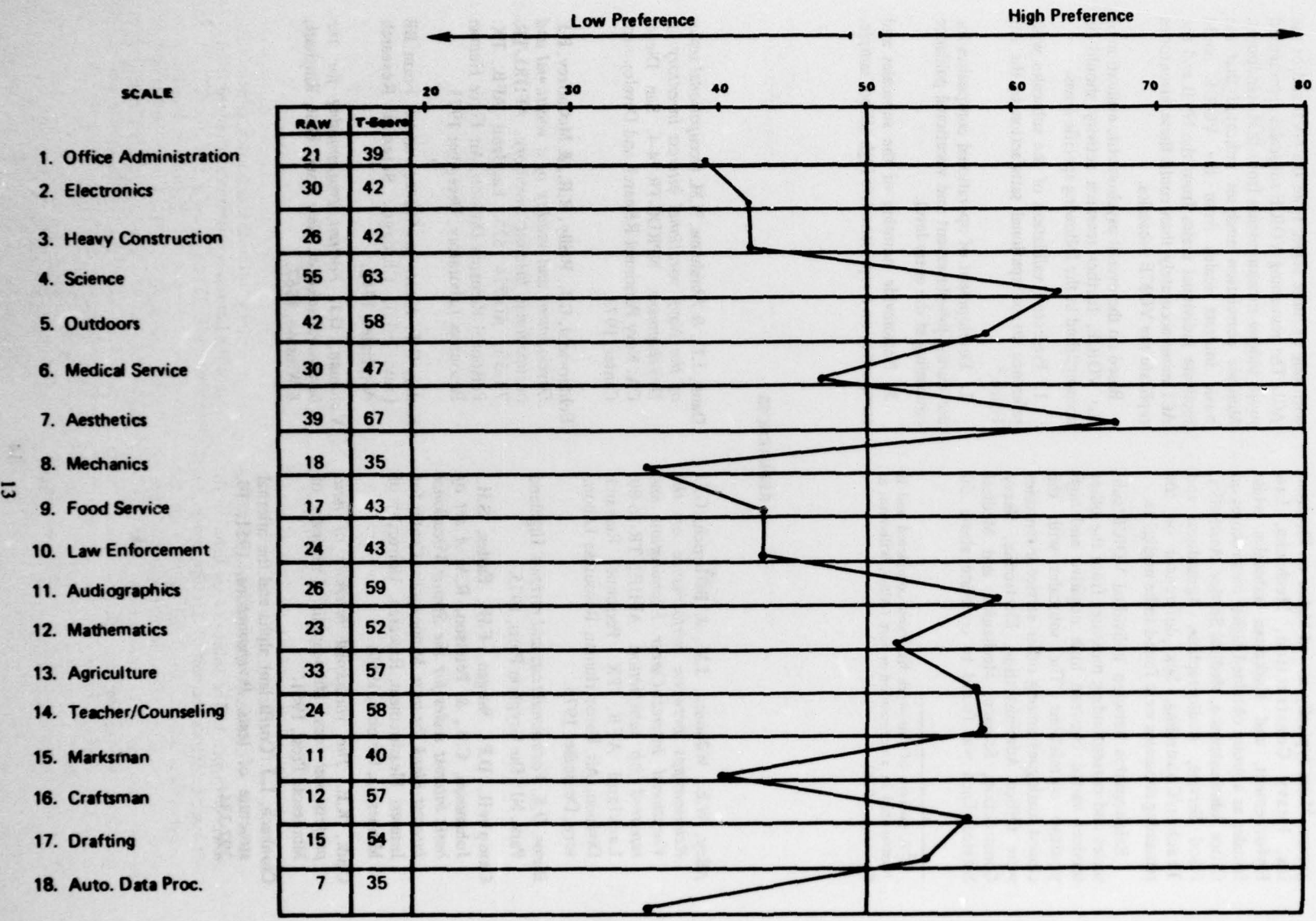

Figure 1. **VOICE interest profile.**

groups. Males typically scored higher on Electronics, Heavy Construction, Mechanics, Law Enforcement, and Marksman subscales while females as a group obtained higher mean scores on Office Administration, Medical Service, Aesthetics, Food Service, Audiographics, Agriculture and Teacher/Counseling. Sex differences on the remaining subscales were found to be negligible.

Relationships between individual VOICE subscales and corresponding measures from the other services varied between high negative and high positive correlations. The subscales with the closest analogues among other service inventories were Office Administration, Electronics, Heavy Construction, Science, Mechanics, and Medical Service. Each was found to correlate above .50 with one or more scales from the NVII and/or the ACI. The remaining VOICE subscales represented more unique measurements from that standpoint. Multiple correlation analyses indicated that the basic interest scales from the VOICE could replicate individual scales from the NVII and the ACI more accurately than could these inventories replicate the VOICE subscales.

Based on the overall psychometric evaluation of the VOICE, further research activity should be accomplished in the following specific areas:

1. Predictive validation of the subscales with reference to occupational satisfaction in the Air Force.[1]

2. Development of operational composites for use during job-placement and vocational guidance counseling at the entry-level.

3. Nationwide norming of the subscales and composites on a representative high school sample.

[1] A portion of this work has been completed and is documented in a companion report (Alley, Wilbourn, & Berberich, 1976).

REFERENCES

Alley, W.E., Wilbourn, J.M., & Berberich, G.L. *Relationships between performance on the Vocational Interest-Career Examination and reported job satisfaction.* AFHRL-TR-76-89. Lackland AFB, TX: Personnel Research Division, Air Force Human Resources Laboratory, December 1976.

Buros, O.K. *Vocational tests and reviews.* Highland Park, NJ: The Gryphon Press, 1975.

Campbell, D.P., Borgen, F.H., Eastes, S.H., Johansson, C.B., & Peterson, R.A. *A set of basic interest scales for the Strong Vocational Interest Blank for men.* Minneapolis: Center for Interest Measurement Research, University of Minnesota, October, 1967.

Clark, K.E. *The vocational interests of non-professional men.* Minneapolis: University of Minnesota Press, 1961.

Cronbach, L.J. Coefficient alpha and the internal structure of tests. *Psychometrica,* 1951, **16,** 297-334.

Dann, J.E., & Abrahams, N.M. *Occupational scales of the Navy vocational interest inventory: I. Development.* NPRDC-TR-74-4. San Diego, CA: Navy Personnel Research and Development Center, 1973.

Echternacht, G.J., Reilly, R.R., & McCaffrey, P.J. *Development and validity of a vocational and occupational interest inventory.* AFHRL-TR-73-38, AD-774 573. Lackland AFB, TX: Personnel Research Division, Air Force Human Resources Laboratory, December 1973.

Kuder, G.F. *Kuder preference record* Form BB (rev. ed.). Chicago: Science Research Associates, 1942.

Veldman, D.J. *Fortran programming for the behavioral sciences.* New York: Holt, Rinehart, & Winston, 1967.

APPENDIX A. SUPPORTING TECHNICAL MATERIAL

Table A1. **VOICE Item Characteristics for Male and Female Air Force Recruits**

No.	Item	Male $\bar{X}$	Male SD	Male R_F	Female $\bar{X}$	Female SD	Female R_F
	Office Administration						
52.	Office worker	1.74	.78	.67	1.98	.82	.71
114.	Make out invoices	1.54	.70	.69	1.79	.80	.74
137.	Check a list of supplies received against those ordered	1.76	.75	.64	1.92	.79	.67
150.	Balance a checkbook	1.79	.76	.62	2.10	.78	.61
173.	Make out work schedules	1.68	.73	.65	1.91	.77	.58
185.	Keep personnel records on employees	1.67	.76	.74	2.02	.82	.70
187.	Prepare income tax returns for other people	1.51	.72	.65	1.58	.78	.53
188.	Make out checks for payment of business bills	1.65	.76	.71	1.94	.83	.72
196.	Supervise an inventory of textile goods	1.58	.73	.66	1.59	.74	.55
201.	Prepare a monthly financial statement for a company	1.54	.75	.73	1.70	.82	.68
206.	Take inventory for a department store	1.54	.72	.70	1.75	.79	.66
231.	Make mimeograph copies of a letter	1.56	.71	.62	1.97	.82	.70
241.	File cards alphabetically	1.53	.73	.69	2.05	.84	.69
247.	Keep detailed records of expenses for a clothing store	1.51	.71	.72	1.69	.80	.68
248.	Use an adding machine to check hand calculations	1.78	.81	.63	2.14	.86	.66
263.	Organize a file system for an office	1.55	.73	.72	1.90	.85	.73
269.	Schedule appointments for other people	1.59	.72	.68	2.15	.81	.65
273.	Help prepare the payroll for a business	1.61	.75	.74	1.85	.84	.73
373.	Bookkeeping	1.66	.79	.62	1.98	.85	.65
380.	Efficient methods for filing and retrieving office records	1.54	.73	.71	1.87	.85	.75
	Heavy Construction						
17.	Construction worker	2.05	.81	.62	1.54	.74	.55
44.	Lumberjack	1.76	.82	.57	1.40	.69	.54
47.	Mason	1.75	.77	.52	1.41	.64	.44
59.	Plumber	1.72	.76	.52	1.32	.59	.39
71.	Sheetmetal worker	1.66	.76	.63	1.21	.49	.47
84.	Toolmaker	1.69	.76	.52	1.31	.58	.38
89.	Welder	1.91	.83	.59	1.36	.64	.44
101.	Dig a ditch	1.29	.56	.52	1.24	.53	.58
110.	Clear stumps and brush with a bulldozer	2.01	.84	.64	1.48	.74	.60
116.	Drive a gasoline truck	1.78	.81	.53	1.35	.64	.47
132.	Do heavy physical labor	1.67	.72	.54	1.47	.66	.50
	Electronics						
25.	Electrician	2.31	.78	.68	1.75	.80	.69
68.	Radio mechanic	2.02	.82	.69	1.60	.76	.73
82.	Technician (electronics)	2.25	.83	.70	1.81	.85	.69
136.	Repair a television set	2.10	.84	.77	1.72	.82	.77
145.	Rewire the electrical system in a car	2.12	.84	.67	1.65	.82	.80
159.	Repair small electrical motors	2.04	.83	.73	1.66	.81	.82
163.	Find a problem in an electric circuit and fix it	2.09	.85	.79	1.71	.84	.80
195.	Repair household electrical appliances	2.00	.84	.77	1.68	.81	.79
207.	Install electrical outlets in a building	1.93	.82	.73	1.47	.72	.79
239.	Design a circuit board	1.87	.85	.66	1.55	.76	.65
259.	Install a telephone	2.03	.82	.65	1.74	.82	.69
260.	Inspect television receivers during assembly for incorrect wiring	1.90	.84	.74	1.50	.73	.73
276.	Find and replace defective transistors	1.99	.85	.79	1.59	.78	.82
277.	Plan an electrical system for a house	2.01	.86	.75	1.54	.77	.76
282.	Test television tubes	1.88	.82	.72	1.58	.75	.73
323.	Build an antenna for a ham radio set	2.00	.84	.68	1.51	.74	.73
336.	Tinker with old radios	2.07	.84	.69	1.65	.81	.73
338.	Read about electronics	1.97	.83	.68	1.54	.74	.66
357.	Build a radio	2.13	.84	.74	1.66	.80	.76
400.	Wiring diagrams	2.02	.86	.67	1.61	.79	.66
	Science						
70.	Scientist	1.97	.85	.73	1.89	.87	.77
95.	Write a scientific report	1.66	.79	.65	1.69	.82	.68
97.	Mix chemical compounds	1.88	.84	.70	1.90	.86	.73
103.	Use chemical laboratory apparatus	1.87	.84	.75	1.91	.87	.77
112.	Record observations from scientific instruments	1.93	.83	.66	2.01	.84	.67
140.	Work in a scientific laboratory	1.95	.87	.79	2.01	.88	.82
147.	Perform experiments using laser beams	2.13	.86	.66	1.90	.88	.62
192.	Determine concentrations of ethyl alcohol	1.70	.79	.64	1.71	.83	.70
199.	Help a scientist perform an experiment	2.00	.86	.75	2.08	.88	.78
217.	Devise special scientific equipment for an experiment	1.87	.85	.72	1.75	.85	.70

Table A1 (*Continued*)

No.	Item	Male $\bar{X}$	Male SD	Male R_F	Female $\bar{X}$	Female SD	Female R_F
	Heavy Construction *(Continued)*						
133.	Help load cartons onto trucks	1.61	.71	.60	1.35	.61	.56
143.	Thread pipe by machine	1.70	.76	.59	1.33	.59	.37
146.	Install heavy machinery in a factory	1.65	.76	.60	1.20	.48	.40
177.	Pour concrete for highway construction	1.69	.77	.69	1.40	.66	.61
212.	Fill potholes in a street	1.43	.65	.56	1.30	.57	.56
224.	Operate a bulldozer or power shovel	2.05	.85	.64	1.51	.77	.58
230.	Help put a new roof on an old house	1.83	.80	.56	1.63	.78	.44
289.	Apply coats of plaster to walls and ceilings	1.50	.70	.52	1.40	.66	.41
296.	Rivet sheet metal	1.66	.76	.62	1.28	.57	.43
	Outdoors						
180.	Work outdoors	2.48	.70	.31	2.56	.67	.35
312.	Go for a 20-mile hike	2.04	.82	.38	2.24	.82	.37
319.	Go canoeing	2.49	.74	.60	2.60	.69	.58
326.	Go deer hunting	2.38	.82	.39	1.68	.86	.22
333.	Ride a trail bike through the woods	2.59	.70	.54	2.63	.68	.53
345.	Go trap shooting	2.25	.84	.45	1.65	.84	.14
349.	Exercise for physical fitness	2.29	.75	.42	2.51	.69	.35
352.	Spend a week at the seashore	2.58	.71	.67	2.86	.44	.61
353.	Go on a picnic	2.54	.69	.65	2.89	.38	.56
355.	Go sailing	2.51	.73	.68	2.74	.58	.65
356.	Learn survival techniques for living in the wilderness	2.50	.74	.61	2.55	.71	.48
360.	Be a skydiver	2.23	.85	.41	2.24	.86	.36
362.	Go fishing	2.49	.73	.50	2.31	.81	.39
367.	Play softball	2.46	.74	.50	2.48	.74	.36
369.	Go camping	2.65	.65	.65	2.73	.59	.60
	Aesthetics						
303.	Read poetry	1.60	.77	.51	2.26	.82	.43
306.	Work for a political cause	1.60	.75	.35	1.68	.79	.31
307.	Browse through a library	1.86	.81	.41	2.35	.78	.39
310.	Read a novel	2.04	.83	.42	2.60	.68	.37
315.	See a Broadway play	1.88	.83	.48	2.48	.74	.50
316.	Participate in a debate	1.82	.82	.38	1.92	.84	.31

No.	Item	Male $\bar{X}$	Male SD	Male R_F	Female $\bar{X}$	Female SD	Female R_F
	Science *(Continued)*						
219.	Determine the age of a fossil	1.89	.84	.60	2.04	.87	.60
227.	Use a microscope to classify bacteria	1.81	.84	.69	2.01	.88	.75
243.	Classify rocks by their physical properties	1.74	.80	.59	1.89	.85	.6
313.	Read articles about science	1.90	.83	.64	1.83	.84	.71
372.	Astronomy	2.09	.85	.57	2.29	.82	.46
375.	Chemistry	1.88	.85	.66	1.92	.87	.68
386.	Meteorology	1.90	.84	.56	1.94	.86	.53
388.	Microscopes	1.92	.84	.64	2.02	.86	.69
391.	Nuclear reactors	2.01	.85	.56	1.67	.81	.52
395.	Radiation belts in space	1.93	.85	.63	1.73	.83	.56
	Medical Service						
20.	Dental hygienist	1.52	.72	.55	1.85	.83	.57
57.	Physical therapist	1.71	.78	.53	2.23	.82	.58
62.	Practical nurse	1.27	.56	.44	1.95	.85	.72
99.	Take blood pressure readings	1.68	.76	.57	2.20	.79	.67
113.	Give first aid to accident victims	2.06	.80	.44	2.19	.83	.64
142.	Assist a surgeon during an operation	1.74	.83	.60	1.97	.90	.73
154.	Take X-rays of broken bones	1.95	.82	.58	2.27	.81	.68
210.	Work in a hospital	1.79	.80	.64	2.20	.84	.77
213.	Give antirabies shots to dogs	1.66	.80	.44	1.90	.88	.41
237.	Work out special diets for sick people	1.46	.68	.47	1.81	.83	.46
238.	Test other people's vision using an eye chart	1.66	.75	.47	2.02	.82	.46
244.	Perform physical therapy	1.67	.78	.59	2.17	.85	.62
249.	Take blood samples from humans	1.61	.77	.67	1.90	.88	.77
256.	Give injections to people for immunizations	1.59	.77	.69	1.88	.88	.77
265.	Supervise activities for mentally ill patients	1.52	.73	.47	1.94	.87	.50
268.	Help give physical examinations	1.67	.77	.63	2.05	.86	.74
274.	Assist a dentist by cleaning teeth	1.51	.72	.60	1.79	.85	.62
278.	Fill prescriptions for a doctor	1.70	.79	.53	2.19	.83	.55
378.	Disease prevention	1.77	.79	.48	2.20	.81	.54
393.	Performance of emergency medical operations	1.86	.84	.51	2.09	.88	.67
	Mechanics						
49.	Mechanic (automobile)	2.25	.81	.61	1.81	.84	.48
94.	Replace valves in an engine	2.07	.84	.63	1.63	.80	.40
96.	Install a radio in a car	2.21	.79	.38	1.82	.83	.28
135.	Perform routine maintenance on farm tractors	1.80	.81	.40	1.44	.69	.22
148.	Overhaul a tractor engine	1.93	.86	.56	1.44	.72	.33
155.	Adjust the brakes on an automobile	2.12	.83	.61	1.73	.83	.46

Table A1 (*Continued*)

No.	Item	Male $\bar{X}$	Male SD	Male R_F	Female $\bar{X}$	Female SD	Female R_F
	Aesthetics *(Continued)*						
321.	Discuss a painting	1.69	.78	.48	2.00	.85	.46
329.	Read Shakespeare's plays	1.59	.76	.59	2.03	.85	.57
335.	Listen to an opera	1.44	.69	.61	1.67	.81	.66
339.	Watch educational television	1.85	.79	.40	2.03	.80	.33
342.	Tune a musical instrument	1.81	.84	.38	1.88	.85	.41
346.	Read short stories	2.09	.83	.44	2.64	.65	.34
347.	Go to a symphony concert	1.67	.81	.63	2.05	.88	.72
351.	Watch a ballet	1.43	.70	.58	2.04	.87	.67
377.	Classical music	1.73	.81	.58	2.14	.84	.68
	Food Service						
6.	Baker	1.43	.66	.62	1.77	.79	.67
13.	Chef	1.52	.72	.65	1.73	.81	.70
86.	Waiter	1.22	.50	.42	1.39	.64	.40
121.	Mix pancake batter	1.30	.58	.62	1.77	.81	.64
127.	Plan menus	1.34	.61	.50	1.79	.81	.64
167.	Decorate cakes	1.36	.62	.64	2.16	.83	.59
179.	Carry out dirty dishes in a restaurant	1.16	.43	.39	1.22	.49	.37
234.	Manage a cafeteria	1.43	.66	.45	1.50	.71	.54
253.	Work as a short-order cook	1.34	.61	.62	1.39	.67	.62
264.	Run a food catering service	1.37	.63	.52	1.48	.72	.64
297.	Make ice cream	1.60	.74	.45	2.11	.84	.55
324.	Improve a recipe	1.51	.72	.52	2.19	.84	.56
328.	Buy food for a cookout	1.77	.78	.39	2.35	.79	.48
376.	Chinese cooking	1.56	.75	.45	2.11	.86	.48
381.	Food processing	1.46	.67	.51	1.77	.81	.65
	Audiographics						
55.	Photoengraver	1.68	.74	.43	1.86	.77	.45
56.	Photographer	2.24	.80	.65	2.54	.68	.69
83.	Television cameraman	2.24	.81	.47	2.15	.83	.52
115.	Take aerial photographs	2.35	.79	.54	2.43	.76	.57
141.	Draw maps from photographs	1.85	.83	.30	1.93	.85	.29
157.	Operate a 16mm movie camera	2.21	.78	.62	2.42	.74	.67
158.	Repair cameras	1.93	.81	.50	1.83	.82	.42
225.	Record the sound track for a motion picture	2.14	.83	.48	2.27	.80	.55
228.	Develop photographs	2.09	.83	.63	2.46	.74	.69
358.	Join a photography club	1.69	.77	.55	2.38	.78	.64
	Mechanics *(Continued)*						
209.	Supervise work in a garage	1.82	.81	.44	1.45	.69	.29
290.	Design a dragster	2.20	.85	.46	1.68	.84	.27
305.	Write articles for automobile magazines	1.72	.80	.43	1.39	.65	.27
331.	Tune-up a car	2.32	.81	.66	1.76	.86	.51
334.	Watch drag racing	2.44	.80	.40	2.20	.85	.22
343.	Change the oil in a car	2.20	.80	.60	1.82	.85	.50
344.	Rebuild a lawn-mower engine	2.09	.86	.54	1.47	.73	.24
348.	Adjust a carburetor	2.22	.83	.65	1.72	.84	.49
384.	How different types of engines work	2.24	.84	.56	1.75	.84	.38
	Law Enforcement						
4.	Ambulance driver	1.86	.82	.37	1.64	.77	.37
19.	Customs agent	1.91	.79	.40	2.10	.79	.32
27.	Explosives detonator	1.84	.83	.33	1.37	.66	.31
30.	Fire fighter	2.00	.80	.48	1.66	.78	.48
31.	Fire inspector	1.86	.77	.39	1.62	.72	.40
36.	Highway patrolman	2.18	.83	.71	1.91	.84	.68
60.	Policeman	2.08	.84	.75	2.03	.86	.69
64.	Prison guard	1.47	.72	.56	1.31	.62	.52
65.	Private investigator	2.21	.83	.56	2.17	.85	.52
100.	Investigate insurance claims	1.92	.84	.43	1.90	.83	.40
128.	Arrest a traffic violator	1.98	.82	.69	1.89	.83	.65
130.	Be a witness at a criminal trial	1.77	.76	.46	1.74	.78	.50
144.	Help rescue someone from a fire	2.31	.77	.42	2.19	.81	.41
160.	Stop a prison riot	1.65	.80	.62	1.46	.73	.54
184.	Fight a forest fire	2.17	.82	.42	1.92	.85	.42
	Mathematics						
91.	Find information in numerical tables	1.64	.76	.38	1.82	.81	.44
105.	Construct mathematical tables	1.63	.78	.55	1.59	.79	.66
156.	Solve arithmetic problems	1.86	.83	.67	1.93	.86	.75
166.	Work with numbers	1.89	.82	.63	2.01	.85	.72
169.	Use a table of logarithms to solve a mathematics problem	1.68	.80	.63	1.66	.82	.69
242.	Correct errors made by another person in an arithmetic problem	1.65	.78	.50	1.87	.85	.58
301.	Devise shortcut methods for adding numbers	1.78	.84	.48	1.86	.87	.52
340.	Solve geometry problems	1.71	.80	.57	1.62	.80	.64
371.	Algebra	2.01	.81	.61	2.08	.89	.67
374.	Calculus	1.68	.80	.56	1.66	.81	.61
389.	How to multiply numbers on a desk calculator	1.96	.85	.42	2.12	.86	.46
399.	Use of a slide rule	1.98	.84	.44	1.84	.85	.51

Table A1 (*Continued*)

No.	Item	Male $\bar{X}$	Male SD	Male R_F	Female $\bar{X}$	Female SD	Female R_F
	Agriculture						
29.	Farmer	1.77	.81	.54	1.89	.84	.57
33.	Forest ranger	2.39	.77	.50	2.23	.84	.56
34.	Gardener	1.55	.72	.52	1.97	.83	.56
85.	Veterinarian	1.82	.84	.39	2.16	.86	.49
106.	Work as a game warden	2.31	.83	.47	2.14	.87	.55
123.	Train animals	2.02	.84	.41	2.34	.82	.54
124.	Pick fruit in an orchard	1.35	.60	.32	1.73	.78	.40
125.	Mow lawns, clip hedges and bushes, and trim trees	1.42	.65	.34	1.66	.78	.44
172.	Drive a tractor on a farm	1.86	.84	.40	1.79	.85	.42
180.	Work outdoors	2.48	.70	.30	2.56	.67	.43
189.	Plant trees in a forest	2.11	.83	.51	2.20	.84	.60
213.	Give antirabies shots to dogs	1.66	.80	.33	1.90	.88	.41
232.	Experiment on plants with different types of fertilizer	1.78	.80	.38	2.04	.85	.43
302.	Plant and take care of a vegetable garden	1.73	.80	.52	2.29	.82	.51
396.	How to raise tropical plants	1.76	.80	.35	2.15	.84	.42
	Marksman						
35.	Gunsmith	2.05	.81	.56	1.52	.73	.55
119.	Teach marksmanship	2.16	.82	.48	1.87	.85	.46
246.	Replace defective parts on a rifle	2.04	.82	.47	1.56	.76	.46
326.	Go deer hunting	2.38	.82	.48	1.68	.86	.53
345.	Go trap shooting	2.25	.84	.44	1.65	.84	.57
363.	Collect rifles and pistols	2.28	.82	.58	1.60	.80	.70
368.	Belong to a gun club	2.23	.83	.58	1.66	.83	.71
	Drafting						
5.	Artist	1.83	.85	.33	2.16	.85	.46
22.	Draftsman	2.02	.81	.60	1.70	.78	.49
104.	Draw blueprints for a bridge	2.01	.84	.61	1.81	.84	.51
134.	Draw graphs	1.82	.80	.52	1.82	.81	.50
141.	Draw maps from photographs	1.85	.83	.48	1.93	.85	.49
175.	Make drawings with a compass, triangle, ruler, and other instruments	2.00	.85	.55	1.94	.87	.45
222.	Draw a topographical map of the United States	1.73	.79	.46	1.73	.82	.46
	Teacher/Counseling						
80.	Teacher	1.90	.83	.36	2.12	.82	.49
170.	Give on-the-job training	2.20	.76	.35	2.31	.75	.48
183.	Teach someone to read	1.91	.82	.38	2.39	.77	.54
211.	Teach someone how to solve a problem	2.04	.81	.43	2.30	.79	.56
215.	Organize and lead a study group	1.69	.77	.37	1.93	.82	.59
229.	Give a talk before a small group	1.77	.78	.39	1.97	.82	.57
235.	Help a high school student with his homework	1.89	.78	.38	2.24	.77	.55
254.	Listen to people's problems and try to help them	2.03	.83	.40	2.44	.75	.53
257.	Solve problems by analyzing them logically	1.97	.85	.31	2.25	.82	.41
300.	Organize recreational activities for a group of people	1.92	.83	.32	2.26	.81	.52
	Craftsman						
38.	Jeweler	1.63	.74	.30	2.09	.80	.30
63.	Printer	1.56	.71	.31	1.67	.74	.10
73.	Shoe repairman	1.27	.53	.39	1.22	.49	.24
75.	Steamfitter	1.34	.59	.30	1.15	.40	.16
78.	Tailor	1.36	.62	.35	1.55	.74	.56
87.	Watchmaker	1.50	.70	.34	1.48	.69	.24
98.	Sew clothes from patterns	1.22	.52	.28	2.06	.87	.60
	Automated Data Processing						
15.	Computer operator	2.26	.79	.70	2.26	.79	.77
16.	Computer programmer	2.23	.80	.70	2.22	.80	.77
39.	Keypunch operator	1.71	.79	.45	2.01	.84	.53
151.	Write a computer program	1.92	.85	.51	1.93	.84	.59
174.	Find the errors in a computer program	1.91	.85	.44	1.86	.84	.52
250.	Operate a machine that sorts punched cards	1.75	.80	.34	1.92	.84	.42
262.	Perform maintenance on a computer	1.99	.85	.41	1.65	.79	.39

Table A2. **Multiple Correlation Analysis – VOICE vs. NVII-Lambda Scales**

VOICE to Predict NVII-Lambda				NVII-Lambda to Predict VOICE			
	Multiple R				Multiple R		
Subscale	Full	HS1	CV	Subscale	Full	HS1	CV
Quartermaster	.73	.71	.75	Office Admin.	.65	.66	.63
Sonar Tech.	.84	.82	.84	Electronics	.75	.74	.74
Electronics Tech.	.84	.84	.84	Hvy Construction	.61	.63	.58
Radio Man	.79	.78	.78	Science	.71	.73	.69
Data Processing	.71	.70	.70	Outdoors	.48	.48	.47
Store Keeper	.72	.73	.69	Med. Svc.	.66	.69	.62
Commissary Man	.70	.70	.69	Aesthetics	.53	.55	.50
Engine Man	.87	.87	.86	Mechanics	.70	.70	.69
Boiler Man	.86	.87	.85	Food Service	.49	.51	.46
Electrician's Mate	.85	.85	.85	Law Enforce.	.40	.40	.39
Equip. Operator	.85	.85	.84	Audiographics	.45	.44	.45
Aviation Ord. Man	.84	.84	.84	Mathematics	.64	.65	.62
Air Control Man	.75	.72	.75	Agriculture	.47	.48	.46
Aviation Elect.	.85	.84	.85	Teach/Counsel	.50	.52	.47
Hospital Corpsman	.78	.80	.76	Marksman	.49	.49	.47
				Craftsman	.28	.30	.22
				Draftsman	.58	.59	.57
				Auto. Data Proc.	.57	.57	.56

Full – Full sample (N = 1,390) HS1 – Half sample 1 (N = 695) CV – Results from half sample 1 cross-validated to half sample 2.

Table A3. **Multiple Correlation Analysis – VOICE vs. NVII-Area Scales**

VOICE to Predict NVII Area				NVII Area to Predict VOICE			
	Multiple R				Multiple R		
Subscale	Full	HS1	CV	Subscale	Full	HS1	CV
Mechancial	.84	.85	.83	Office Admin.	.62	.62	.62
Health	.78	.81	.73	Electronics	.71	.71	.71
Office	.82	.82	.81	Hvy Construction	.56	.57	.53
Electrical	.81	.82	.81	Science	.57	.58	.55
Food Service	.66	.69	.63	Outdoors	.32	.33	.28
Carpentry	.60	.62	.58	Med. Svc.	.59	.63	.55
Sales Office	.67	.71	.62	Aesthetics	.48	.52	.42
Clean Hands	.61	.63	.57	Mechanics	.66	.67	.63
Outdoors	.69	.70	.66	Food Service	.45	.49	.41
				Law Enforce.	.22	.20	.20
				Audiographics	.39	.40	.36
				Mathematics	.39	.40	.37
				Agriculture	.37	.39	.36
				Teach/Counsel	.44	.47	.39
				Marksman	.37	.41	.35
				Craftsman	.17	.20	.10
				Draftsman	.32	.33	.28
				Auto. Data Proc.	.49	.48	.50

Full – Full sample (N = 1,390) HS1 – Half sample 1 (N = 695) CV – Results from half sample 1 cross-validated to half sample 2.

Table A4. **Multiple Correlation Analysis – VOICE vs. ACI Scales**

VOICE to Predict ACI				ACI to Predict VOICE			
	Multiple R				Multiple R		
Subscale	Full	HS1	CV	Subscale	Full	HS1	CV
Combat	.62	.62	.60	Office Admin.	.63	.64	.62
Mechanical	.81	.82	.78	Electronics	.75	.75	.75
Electronics	.83	.84	.83	Hvy Construction	.62	.64	.60
Administrative	.69	.72	.66	Science	.59	.58	.59
				Outdoors	.51	.52	.50
				Med. Svc.	.26	.26	.26
				Aesthetics	.42	.44	.39
				Mechanics	.79	.81	.77
				Food Service	.17	.14	.17
				Law Enforce.	.42	.41	.42
				Audiographics	.39	.36	.41
				Mathematics	.73	.73	.71
				Agriculture	.39	.37	.37
				Teach/Counsel	.53	.53	.53
				Marksman	.56	.58	.52
				Craftsman	.32	.30	.32
				Draftsman	.45	.45	.45
				Auto. Data Proc.	.56	.57	.55

Full – Full sample (N = 1,390) HS1 – Half sample 1 (N = 695) CV – Results from half sample 1 cross-validated to half sample 2.

Table A5. **T-Score Conversion Tables for Male Air Force Recruits**

Office Administration		Electronics		Heavy Construction		Science		Outdoors		Medical Service		Aesthetics		Mechanics		Food Service	
Raw	T	Raw	T	Raw	T	Raw	T	Raw	T	Raw	T	Raw	T	Raw	T	Raw	T
20	38	20	34	20	37	20	36	15	19	20	37	15	36	15	31	15	40
21	39	21	35	21	38	21	37	16	20	21	38	16	37	16	33	16	41
22	40	22	35	22	39	22	37	17	22	22	39	17	38	17	34	17	43
23	41	23	36	23	40	23	38	18	23	23	40	18	40	18	35	18	45
24	42	24	37	24	40	24	39	19	25	24	41	19	41	19	36	19	46
25	43	25	38	25	41	25	40	20	26	25	42	20	42	20	37	20	48
26	44	26	38	26	42	26	41	21	28	26	43	21	43	21	38	21	49
27	45	27	39	27	43	27	41	22	29	27	44	22	45	22	39	22	51
28	46	28	40	28	44	28	42	23	30	28	45	23	46	23	40	23	53
29	47	29	41	29	45	29	43	24	32	29	46	24	47	24	41	24	54
30	48	30	42	30	46	30	44	25	33	30	47	25	49	25	43	25	56
31	49	31	42	31	47	31	44	26	35	31	48	26	50	26	44	26	57
32	50	32	43	32	48	32	45	27	36	32	49	27	51	27	45	27	59
33	51	33	44	33	49	33	46	28	38	33	50	28	52	28	46	28	61
34	52	34	45	34	50	34	47	29	39	34	51	29	54	29	47	29	62
35	52	35	46	35	51	35	48	30	41	35	52	30	55	30	48	30	64
36	53	36	46	36	52	36	48	31	42	36	52	31	56	31	49	31	65
37	54	37	47	37	53	37	49	32	43	37	53	32	58	32	50	32	67
38	55	38	48	38	54	38	50	33	45	38	54	33	59	33	51	33	68
39	56	39	49	39	55	39	51	34	46	39	55	34	60	34	53	34	70
40	57	40	49	40	56	40	52	35	48	40	56	35	62	35	54	35	72
41	58	41	50	41	57	41	52	36	49	41	57	36	63	36	55	36	73
42	59	42	51	42	58	42	53	37	51	42	58	37	64	37	56	37	75
43	60	43	52	43	59	43	54	38	52	43	59	38	65	38	57	38	76
44	61	44	53	44	60	44	55	39	54	44	60	39	67	39	58	39	78
45	62	45	53	45	61	45	56	40	55	45	61	40	68	40	59	40	80
46	63	46	54	46	62	46	56	41	57	46	62	41	69	41	60	41	81
47	64	47	55	47	63	47	57	42	58	47	63	42	71	42	62	42	83
48	65	48	56	48	64	48	58	43	59	48	64	43	72	43	63	43	84
49	66	49	56	49	65	49	59	44	61	49	65	44	73	44	64	44	86
50	67	50	57	50	66	50	59	45	62	50	66	45	74	45	65	45	87
51	67	51	58	51	67	51	60			51	67						
52	68	52	59	52	68	52	61			52	68						
53	69	53	60	53	69	53	62			53	69						
54	70	54	60	54	70	54	63			54	70						
55	71	55	61	55	71	55	63			55	70						
56	72	56	62	56	72	56	64			56	71						
57	73	57	63	57	73	57	65			57	72						
58	74	58	64	58	74	58	66			58	73						
59	75	59	64	59	75	59	67			59	74						
60	76	60	65	60	76	60	67			60	75						

Table A5 (*Continued*)

[illegible]		Audio-graphics		Mathematics		Agriculture		Teacher/ Counseling		Marksman		Craftsman		Drafting		Automated Data Processing	
Raw	T	Raw	T	Raw	T	Raw	T	Raw	T	Raw	T	Raw	T	Raw	T	Raw	T
15	31	10	31	12	37	15	32	10	34	7	30	7	40	7	35	7	35
16	32	11	33	13	38	16	33	11	35	8	33	8	44	8	37	8	37
17	33	12	35	14	40	17	35	12	37	9	35	9	47	9	40	9	39
18	35	13	37	15	41	18	36	13	39	10	37	10	50	10	42	10	42
19	36	14	38	16	43	19	37	14	41	11	40	11	54	11	45	11	44
20	37	15	40	17	44	20	39	15	42	12	42	12	57	12	47	12	46
21	39	16	42	18	45	21	40	16	44	13	44	13	61	13	49	13	48
22	40	17	44	19	47	22	42	17	46	14	47	14	64	14	52	14	51
23	41	18	45	20	48	23	43	18	48	15	49	15	67	15	54	15	53
24	43	19	47	21	49	24	44	19	49	16	51	16	71	16	57	16	55
25	44	20	49	22	51	25	46	20	51	17	54	17	74	17	59	17	57
26	45	21	50	23	52	26	47	21	53	18	56	18	78	18	61	18	59
27	47	22	52	24	53	27	49	22	55	19	58	19	81	19	64	19	62
28	48	23	54	25	55	28	50	23	56	20	61	20	84	20	66	20	64
29	49	24	56	26	56	29	51	24	58	21	63	21	88	21	68	21	66
30	51	25	57	27	57	30	53	25	60								
31	52	26	59	28	59	31	54	26	62								
32	54	27	61	29	60	32	56	27	63								
33	55	28	63	30	62	33	57	38	65								
34	56	29	64	31	63	34	58	29	67								
35	58	30	66	32	64	35	60	30	69								
36	59			33	66	36	61										
37	60			34	67	37	63										
38	62			35	68	38	64										
39	63			36	70	39	65										
40	64					40	67										
41	66					41	68										
42	67					42	70										
43	68					43	71										
44	70					44	72										
45	71					45	74										

Table A6. **T-Score Conversion Tables for Female Air Force Recruits**

Office Administration		Electronics		Heavy Construction		Science		Outdoors		Medical Service		Aesthetics		Mechanics		Food Service	
Raw	T	Raw	T	Raw	T	Raw	T	Raw	T	Raw	T	Raw	T	Raw	T	Raw	T
20	34	20	40	20	41	20	36	15	12	20	32	15	27	15	38	15	34
21	35	21	41	21	42	21	37	16	14	21	33	16	29	16	40	16	36
22	36	22	41	22	43	22	37	17	16	22	34	17	30	17	41	17	37
23	37	23	42	23	45	23	38	18	18	23	34	18	31	18	42	18	38
24	38	24	43	24	46	24	39	19	19	24	35	19	33	19	43	19	40
25	39	25	44	25	47	25	40	20	21	25	36	20	34	20	44	20	41
26	40	26	45	26	48	26	40	21	23	26	37	21	35	21	45	21	42
27	41	27	45	27	49	27	41	22	25	27	38	22	37	22	46	22	44
28	41	28	46	28	51	28	42	23	26	28	39	23	38	23	48	23	45
29	42	29	47	29	52	29	43	24	28	29	40	24	39	24	49	24	46
30	43	30	48	30	53	30	44	25	30	30	41	25	41	25	50	25	48
31	44	31	49	31	54	31	44	26	31	31	41	26	42	26	51	26	49
32	45	32	50	32	55	32	45	27	33	32	42	27	44	27	52	27	50
33	46	33	50	33	57	33	46	28	35	33	43	28	45	28	53	28	52
34	47	34	51	34	58	34	47	29	37	34	44	29	46	29	54	29	53
35	48	35	52	35	59	35	47	30	38	35	45	30	48	30	56	30	54
36	48	36	53	36	60	36	48	31	40	36	46	31	49	31	57	31	56
37	49	37	54	37	61	37	49	32	42	37	47	32	50	32	58	32	57
38	50	38	55	38	63	38	50	33	44	38	48	33	52	33	59	33	58
39	51	39	55	39	64	39	51	34	45	39	48	34	53	34	60	34	60
40	52	40	56	40	65	40	51	35	47	40	49	35	54	35	61	35	61
41	53	41	57	41	66	41	52	36	49	41	50	36	56	36	63	36	63
42	54	42	58	42	67	42	53	37	51	42	51	37	57	37	64	37	64
43	54	43	59	43	69	43	54	38	52	43	52	38	58	38	65	38	65
44	55	44	59	44	70	44	55	39	54	44	53	39	60	39	66	39	67
45	56	45	60	45	71	45	55	40	56	45	54	40	61	40	67	40	68
46	57	46	61	46	72	46	56	41	58	46	55	41	63	41	68	41	69
47	58	47	62	47	73	47	57	42	59	47	55	42	64	42	69	42	71
48	59	48	63	48	74	48	58	43	61	48	56	43	65	43	71	43	72
49	60	49	64	49	76	49	58	44	63	49	57	44	66	44	72	44	73
50	61	50	64	50	77	50	59	45	64	50	58	45	68	45	73	45	75
51	61	51	65	51	78	51	60			51	59						
52	62	52	66	52	79	52	61			52	60						
53	63	53	67	53	80	53	62			53	61						
54	64	54	68	54	82	54	62			54	61						
55	65	55	69	55	83	55	63			55	62						
56	66	56	69	56	84	56	64			56	63						
57	67	57	70	57	85	57	65			57	64						
58	68	58	71	58	86	58	65			58	65						
59	68	59	72	59	88	59	66			59	66						
60	69	60	73	60	89	60	67			60	67						

Table A6 (*Continued*)

Law Enforcement		Audio-graphics		Mathematics		Agriculture		Teacher/ Counseling		Marksman		Craftsman		Draftsman		Automated Data Processing	
Raw	T	Raw	T	Raw	T	Raw	T	Raw	T	Raw	T	Raw	T	Raw	T	Raw	T
15	33	10	27	12	36	15	30	10	27	7	39	7	36	7	36	7	34
16	34	11	29	13	38	16	32	11	29	8	41	8	39	8	38	8	37
17	36	12	31	14	39	17	33	12	31	9	44	9	42	9	40	9	39
18	37	13	33	15	41	18	34	13	33	10	46	10	46	10	43	10	41
19	39	14	35	16	42	19	35	14	35	11	49	11	49	11	45	11	43
20	40	15	37	17	43	20	36	15	36	12	51	12	53	12	47	12	46
21	41	16	39	18	45	21	37	16	38	13	53	13	56	12	50	13	48
22	43	17	40	19	46	22	39	17	40	14	56	14	59	14	52	14	50
23	44	18	42	20	47	23	40	18	42	15	58	15	63	15	54	15	53
24	46	19	44	21	49	24	41	19	44	16	61	16	66	16	57	16	55
25	47	20	46	22	50	25	42	20	46	17	63	17	70	17	59	17	57
26	49	21	48	23	51	26	44	21	48	18	65	18	73	18	61	18	59
27	50	22	50	24	53	27	45	22	50	19	68	19	76	19	64	19	62
28	52	23	51	25	54	28	46	23	51	20	70	20	80	20	66	20	64
29	53	24	53	26	55	29	47	24	53	21	72	21	83	21	69	21	66
30	55	25	55	27	57	30	49	25	55								
31	56	26	57	28	58	31	50	26	57								
32	57	27	59	29	59	32	51	27	59								
33	59	28	61	30	61	33	52	28	61								
34	60	29	62	31	62	34	54	29	63								
35	62	30	64	32	63	35	55	30	65								
36	63			33	65	36	56										
37	65			34	66	37	57										
38	66			35	67	38	59										
39	68			36	69	39	60										
40	69					40	61										
41	70					41	62										
42	72					42	64										
43	73					43	65										
44	75					44	66										
45	76					45	67										

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